CONTRIBUTIONS TO THE BIOLOGY OF THE CAPE GURNARD, *TRIGLA CAPENSIS* (PISCES : TRIGLIDAE): AGE, GROWTH AND REPRODUCTION.

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ABSTRACT

Study of otoliths of the Cape gurnard, *Trigla capensis*, has established that the rings are annular. An opaque zone is formed from February to July and a hyaline zone during the spawning season from August to March. Females grow faster than males. The Von Bertalanffy growth equation of the females was found to be
$L_t = 71{,}4\ (1 - e^{-0{,}169(t + 0{,}41)})$ and for the males
$L_t = 58{,}6\ (1-e^{-0{,}288(t + 0{,}28)})$. Male fishes are sexually mature at a total length of 37 cm at the end of the fifth year. The female fishes are all sexually mature at a total length of 35 cm at the age of four years.

INTRODUCTION

The Cape gurnard is a commercially exploited species of which the annual landings between 1967 and 1975 ranged from 19 to 163 metric tons (Hecht in press). To the author's knowledge no previous work has been done on the biology of this fish. It was, therefore, thought necessary to study some aspects of its biology as a contribution to our knowledge of South African fishes and also because the Cape gurnard is one of the six major demersal trawl-fish species along the eastern Cape coast. Moreover, the data is necessary for the umbrella esearch project of the Zoology Department of the University of Port Elizabeth concerning the Algoa Bay ecosystem.

AGE AND GROWTH

Material and methods.

All the fish used in this study were caught by side trawlers of 21 m length, using standard otter trawling gear with 20 m head-ropes and the regulatory 110 mm stretch mesh size. All fishing operations took place along the eastern Cape coast of South Africa from 24° 53,2′ E/34°11,8′ S to 26°28,4′ E/33°52,4′ S, in waters ranging in depth from 54 to 115 m.

Sagittal otoliths of 1149 fish in 2 cm size classes were collected on a monthly basis from April 1974 to September 1975 and cleared in 0,75 per cent NaCl for five days. Ring counts were made from the lateral side. The otoliths were immersed in a petri-dish containing

xylene and read under a stereo-microscope at 6 x and 12 x magnification using transmitted light. Because of the opaque nature of the otolith nucleus the opaque zones were interpreted as indicative of age in years. Each otolith was given a serial number and read four times at two week intervals by the author. When three readings were found to correspond their validity as indicating the fish's age was accepted. Of the 1149 otoliths examined 86 per cent could be aged successfully. All length measurements are total lengths in cm.

Length at age data were fitted to the Von Bertalanffy growth equation:

$$L_t = L_\infty (1 - e^{-K(t-t_0)}).$$

Figure 1 illustrates the relationship between the total fish length and otolith length.

Otolith zonation.

In order to establish the validity of otolith rings as indicators of age, the annual nature of these rings had to be shown. For this purpose the outer edges of a monthly sample of otoliths were examined and the presence of either an opaque or hyaline zone was noted. The number of otoliths examined monthly and the seasonal frequency occurrence of opaque and hyaline zones are illustrated in Figure 2. From this figure it is clear that only a single set of rings is deposited annually.

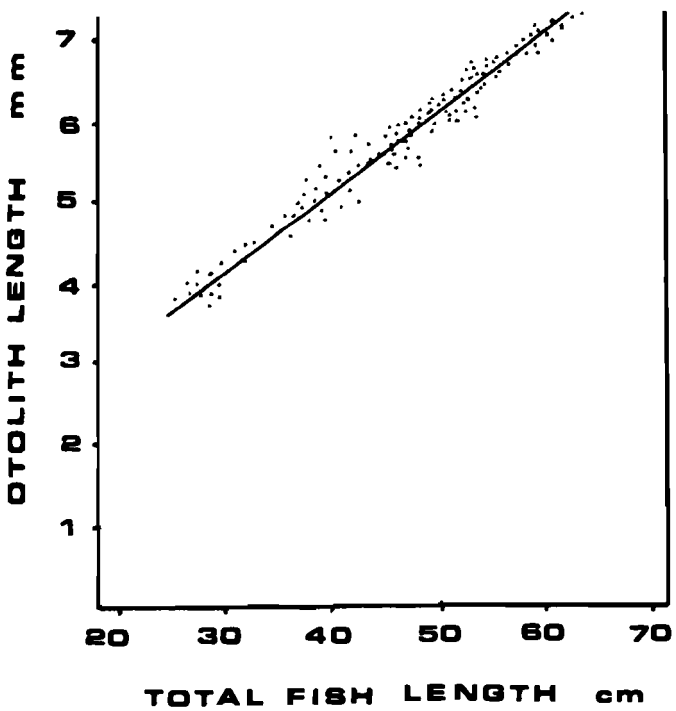

FIGURE 1

Otolith length plotted against total fish length with a straight line fit computed using least squares.

Opaque zone formation takes place from February to June and hyaline zone deposition occurs from July to January.

Growth calculations.

Table 1 shows the mean length at age of male and female fishes. The differences were tested statistically by means of the Student t test and were found to differ at the one per cent level of significance. These results are also shown in Table 1, from which it is clear that females grow faster than males. The observed length at age data of males and females shown in Table 2 were fitted separately, by the method of least squares, to the Von Bertalanffy equation. The length at age data of all fish irrespective of sex (Table 3) were similarly fitted to the growth equation.

The parameters of the Von Bertalanffy equation L_∞, K and t_0 were found to be

	Males	*Females*	*All fish irrespective of sex.*
L_∞	58,6 cm	71,4 cm	70,2 cm
K	0,186	0,169	0,148
T_0	-0,28	-0,41	-0,09

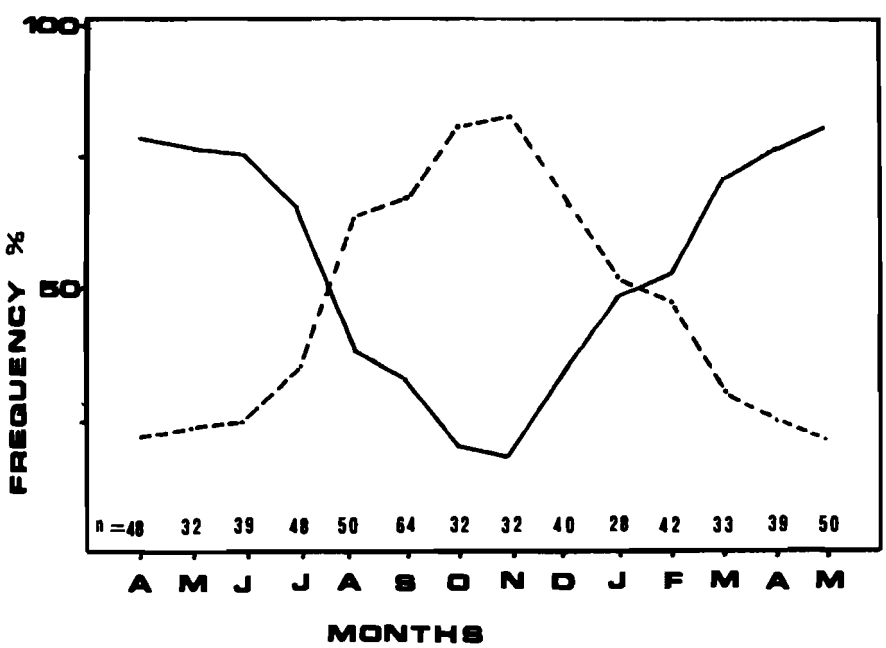

FIGURE 2
Seasonal changes in the marginal character of otoliths.

TABLE 1

Test of significance between the mean length at age of males and females.

Levels of significance: * = $P > 0{,}01$

Age Years	Males			Females				
	$\bar{x}$(cm)	n	S.D.	$\bar{x}$(cm)	n	S.D.	d.F.	t
3	25,1	24	2,91	30,9	29	3,01	51	12,46*
4	31,8	20	2,48	35,8	20	2,61	38	8,75*
5	36,0	28	1,94	39,9	34	1,98	60	12,28*
6	39,0	28	3,81	44,8	28	1,86	54	6,04*
7	42,0	17	2,94	48,1	28	3,04	43	17,08*
8	44,3	29	1,30	51,4	29	2,01	56	10,44*
9	46,0	27	2,31	54,6	30	1,87	55	19,72*
10	48,9	14	1,87	57,8	29	2,86	41	24,58*
11	51,5	6	3,84	59,9	21	2,93	25	29,23*

TABLE 2

Mean observed and calculated length at age of males and females in cm.

	Males				Females			
Age	Observed length	SD	Length increment	Calculated length	Observed length	SD	Length increment	Calculated length
3	25,1	2,4		26,7	30,1	3,5		29,4
			6,7				4,8	
4	31,8	2,6		32,1	35,8	3,3		35,9
			4,2				4,2	
5	36,0	3,1		36,6	40,0	2,1		41,4
			3,0				4,8	
6	39,0	4,7		40,4	44,8	2,4		46,1
			3,0				3,4	
7	42,0	3,1		43,5	48,2	3,6		49,9
			2,3				3,2	
8	44,3	2,4		46,0	51,4	2,4		53,3
			1,7				3,2	
9	46,0	2,0		48,2	54,6	4,8		56,1
			2,9				3,3	
10	49,1	4,0		49,9	57,9	3,4		58,5
			2,5				2,0	
11	51,5	4,7		51,4	59,9	3,8		60,5
							1,3	
12					61,3	4,0		62,2

TABLE 3

Mean observed and calculated length at age of all fish irrespective of sex in cm.

Age	*Observed length*	*S.D.*	*Length increment*	*Calculated length*
4	34,8	4,5		31,9
			3,3	
5	38,1	4,6		37,2
			5,0	
6	43,1	3,3		41,7
			1,9	
7	45,0	5,6		45,7
			3,1	
8	48,1	2,8		49,1
			2,9	
9	51,0	6,9		51,9
			5,5	
10	56,5	5,1		54,5
			0,9	
11	57,4	2,0		56,7
			2,9	
12	60,4	4,9		58,5

The growth of males and females and of all fish irrespective of sex is illustrated in Figure 3. The fact that females become larger than males has been documented by a number of workers for a number of different species (Hickling 1933; Botha 1971; Zoutendyk 1974).

SEXUAL MATURITY ASSESSMENT

Material and methods.

The length and age at sexual maturity were established by macroscopic examination of the gonads after identifying the seven stages of seasonal gonad activity based on Hjort's (in Ehrenbaum 1930) seven-stage International Maturity Scale.

To eliminate possible error the data for establishing length at maturity were only collected during the period of maximum gonad activity. Fish with gonads in Stages I and II were regarded as being immature, and fish with gonads in the subsequent Stages III to VII, i.e. active, active/ripe, ripe, spawning and spent, were considered to be mature.

Results and discussion

During the period September to March the gonads of 285 male and 365 female fishes were examined (Figures 4 and 5). It appears from Figure 4 that male fishes approach sexual maturity at a total length of 29 cm at a corresponding age of between three and four years. More than 50 per cent of the males are sexually mature at *ca.* 34 cm at an age of between four and five years and 100 per cent sexual maturity is attained at a length of 37 cm at the end of the fifth year.

In contrast to the males some females reach sexual maturity at a total length of 27 cm at the end of about their second year (Figure 5). Fifty per cent maturity is attained at a length of about 30,5 cm at an age of approximately three years. All females are sexually mature at a length of 35 cm, at an age of four years. Wheeler (1969) stated that the European gurnard, *Eutrigla gurnardus,* of the North Sea also reaches maturity in either its third or fourth year.

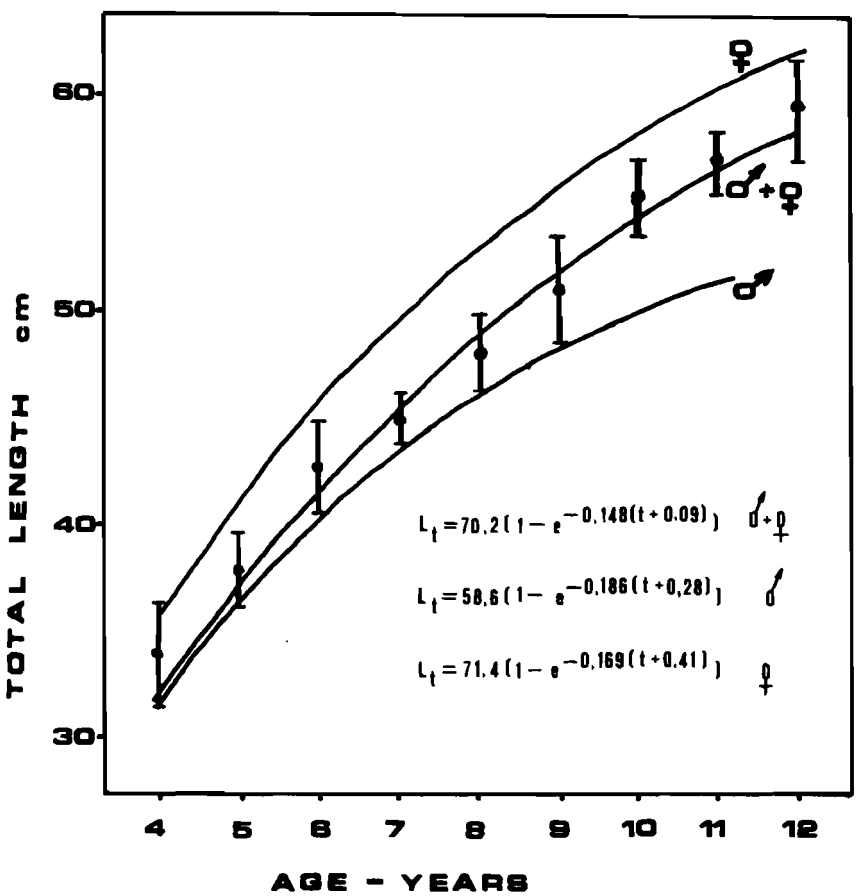

FIGURE 3
Growth in length of males, females and of all fish irrespective of sex.

REPRODUCTION

The breeding season of the Cape gurnard was determined by a monthly visual appraisal of gonad activity (Komarov 1964; Sahrhage 1970; Baird 1974).

Figure 6 indicates, by a high frequency occurrence of ripe ovaries, that the breeding season extends from September to March. The sudden decline in frequency after March probably suggests the end of the reproductive season.

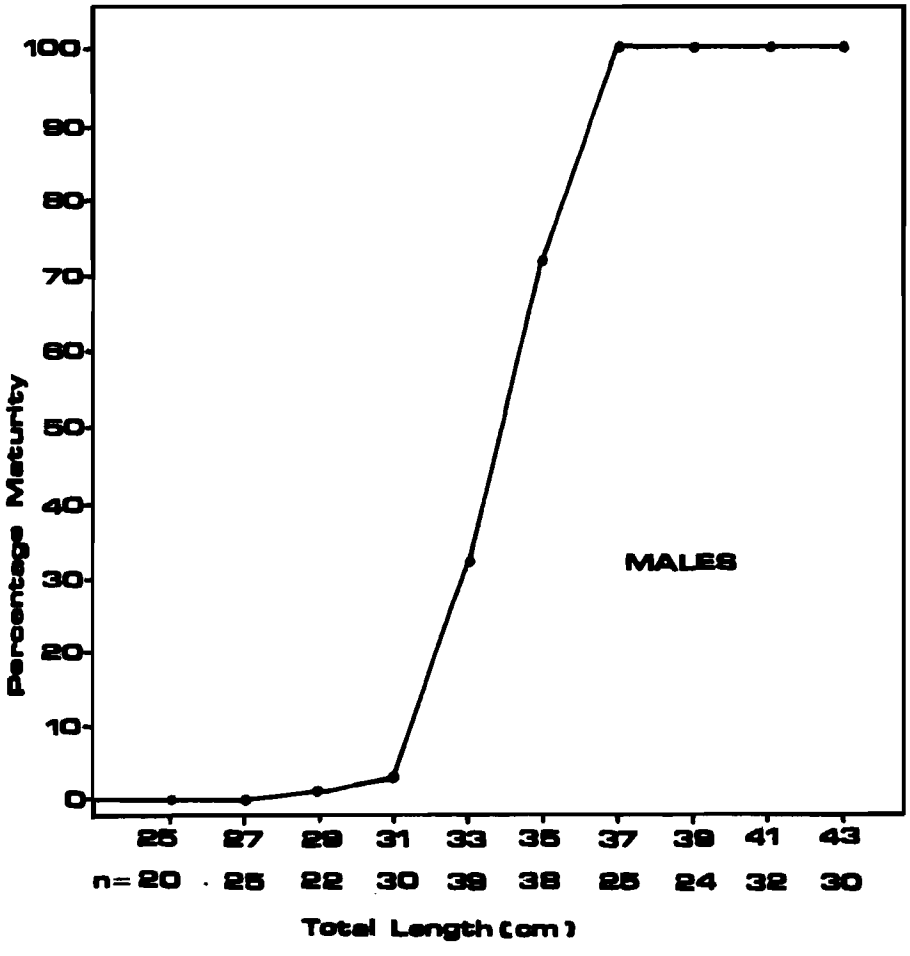

FIGURE 4
Length at sexual maturity of male gurnards.

From the frequency occurrence of spent ovaries it may provisionally be assumed that the Cape gurnard is probably an asynchronous spawner, spawning twice during the relatively long reproductively active period, from November to January and again during the period March to April. The spawning periods are indicated by a sudden increase in the frequency of spent ovaries. The asynchrony of the Cape gurnard's reproductive season will be investigated in greater detail in the near future.

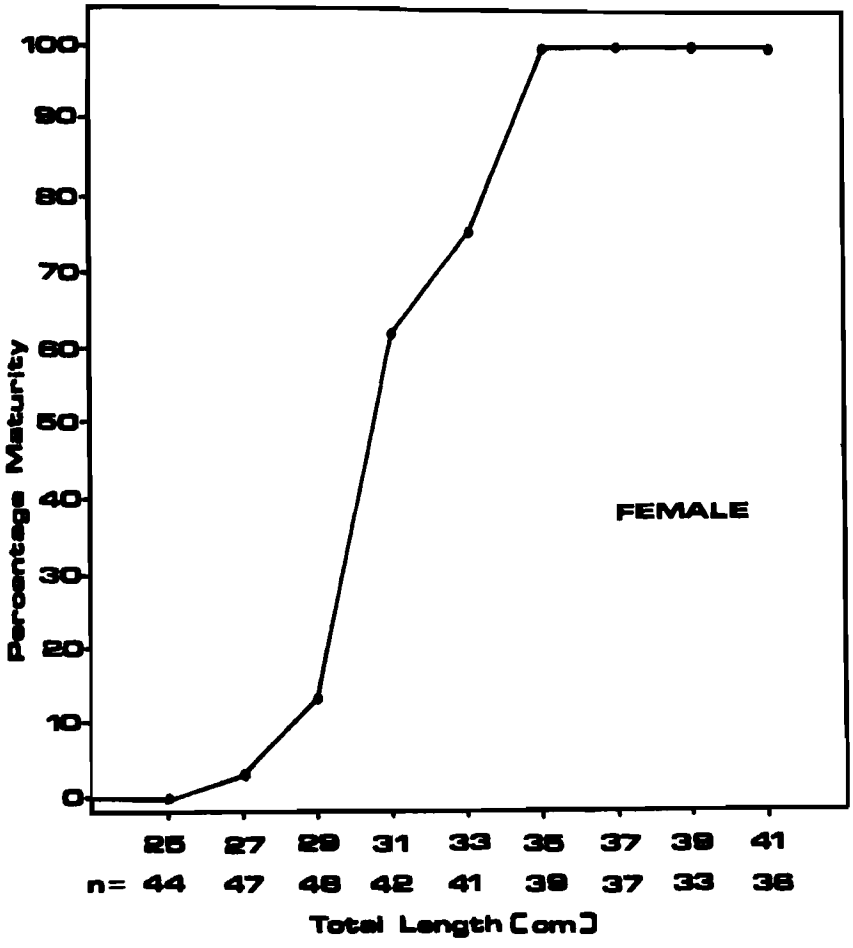

FIGURE 5
Length at sexual maturity of female gurnards.

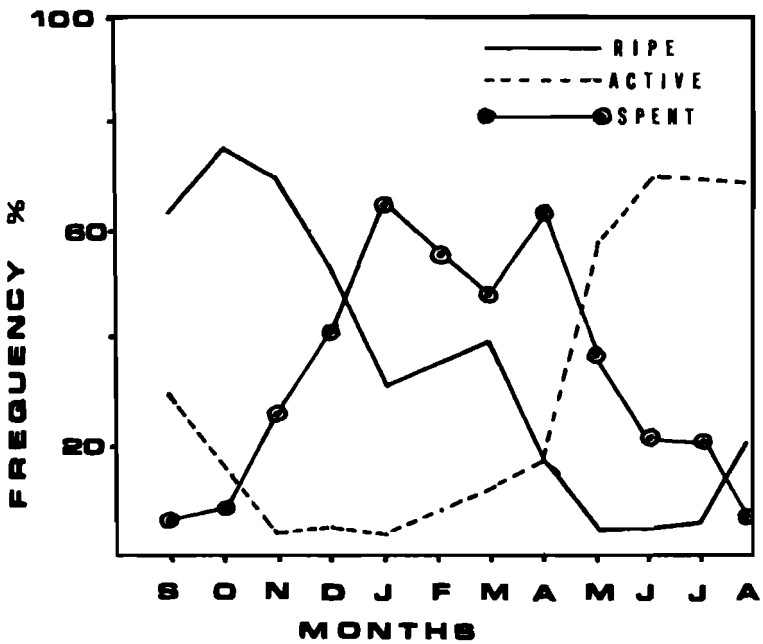

FIGURE 6
The frequency distribution of ovaries in the active, ripe and spent stages of seasonal activity.

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